

Status of Forest Genetic Resources Conservation and Management in Myanmar

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Introduction

General description of the country

Spanning between latitudes 9° to 29° North and longitudes 92° to 102° East, Myanmar is geographically located in the Southeast Asia and bordered on the north and northeast by China, on the east and southeast by Laos, and Thailand, on the south by the Andaman Sea and the Bay of Bengal and on the west by Bangladesh and India. Having the total land area of 676,577 km², the country is richly endowed with diverse habitat types and natural resources, culture and traditions. More than 50% of the country's total area is forested. Myanmar is best known as the natural home to teak (*Tectona grandis*), which is regarded worldwide as one of the most valuable premier wood.

Myanmar possesses a broad ecological spectrum ranging from the snow capped mountains through tropical rain forests to coastal and marine ecosystems. Population reached about 53 million in 2004 with a growth rate of 1.84%. There is no denying the fact that the forests in Myanmar are socially and economically significant. As a matter of fact, over 70% of the country's population is rural and dependent on forest resources for their basic needs and livelihoods. The forestry sector contributed about 30% of the country's total exporting earning in the 1990s.

Timber export constitutes a major source of foreign exchange earning for the country's economy. As a result, extraction of teak and other commercial hardwood species is inevitable and to some extent the natural forests and forest genetic resources are affected. According to the forest resource assessment conducted in 1990, forest cover decreased at an annual rate of 220,000 ha or 0.64% of forested area between 1975 and 1989. FAO (1999) estimated that an area of 387,000 ha or 1.4% of forested area of Myanmar was destroyed annually between 1990 and 1995. The continued degradation of the country's forests will not only reduce earning of foreign exchange, it will also significantly affect environmental quality with serious consequences in watershed protection and hence agricultural production and living conditions. Therefore, strong measures must be taken to conserve and maintain existing natural forests to avoid further loss of forest resources.

The Forest Department (FD) of the Ministry of Forestry (MOF) is responsible for protection and conservation of biodiversity and sustainable management of the forest resources of the country. Forest genetic resources conservation (FGRC) including teak was started in 1984. Since then, conversion of teak plantations into seed production areas (SPA), and establishment of teak hedge gardens (THGs), teak seed orchards and protected areas system (PAS) have been the major FGR conservation and management (FGR C&M) activities in Myanmar.

Forest resource base

The forest flora of Myanmar is diverse, varying from sub-alpine, dry and moist deciduous forests, tropical rain forests to mangrove forests. The forest types vary depending on topographic, edaphic and climatic conditions. They are classified as mangroves and estuarine forests in the delta region; deciduous and dipterocarpus forests in the regions with pronounced dry season; evergreen forest in areas of high moisture regime and rainfall; hill evergreen and sub-alpine forest at high altitudes and subtropical regions; and dry thorn forests in places with scanty rainfall. Tables 1 and 2 show the status of forest cover and major forest types of Myanmar in 2002 respectively.

Table 1. Forest cover status in 2002 (Source: Forestry in Myanmar, 2003)

<i>Category</i>	<i>Area (sq. km)</i>	<i>Percent of total land area</i>
Closed Forests	252,939	37.38
Open Forests	100,808	14.90
Total Natural Forests	353,747	52.28
Shrubs	107,232	15.85
Forest Fallows	11,961	1.77
Total Open-wooded Lands	119,193	17.62
Other Lands	203,637	30.10
Total Land Area	676,577	100.00

Table 2. Status of major forest types in 2002 (Forestry in Myanmar, 2003).

<i>Types of forests</i>	<i>Area (sq.km)</i>	<i>Percent of total forest area</i>
Tidal forest, beach and dune forest, swamp forest	13,750	4
Tropical evergreen forest	55,004	16
Mixed deciduous forest	134,068	38
Dry forest	34,377	10
Deciduous Indaing (dipterocarp) forest	17,187	5
Hill and temperate evergreen forest	89,378	25
Fallow land	9,983	2
Total	353,747	100

In Myanmar, reserved forests, protected public forests and protected areas system constitute permanent forest estate (PFE). The status of PFE of Myanmar in 2002 is provided in Table 3.

Table 3. Status of PFE in Myanmar in 2002 (Forestry in Myanmar, FD, 2003).

<i>Legal classification</i>	<i>Area (sq. km)</i>	<i>Percent of land area</i>
Reserved Forest	114,995	17.00 %
Public Protected Forest	26,799	3.96 %
Protected Area System	31,945	4.72 %
Total area of PFE	173,739	25.68 %
Unclassified forest area	180,008	26.60 %
Total	353,747	52.28 %

Natural forests in Myanmar have been managed and conserved on a sustainable basis including biodiversity conservation. Myanmar still possesses a diverse species of flora and fauna. At present, 11,800 plant species, 2,371 genera and 273 families have already been

identified. Among plant species, only 85 species are being used as commercial timber species because of their prominent high quality (FD, 2000). The properties and end-uses of other plant species need to be investigated in order to increase commercial timber production and to release the pressure on a few commercial timber species. Table 4 shows the status of plant genetic resources in Myanmar.

Table 4. The plant genetic resources of Myanmar (Forest Department, 2003).

<i>Categories</i>	<i>No. of species</i>
Plants	11800
Bamboo	96
Rattan	50
Shrubs	1696
Orchids	841

Management system

Myanmar Selection System (MSS) has been the principle forest management system applied in managing natural forests in Myanmar since 1856. It is an exploitation-cum-cultural system. The system prescribes a felling cycle of 30 years for a felling series. Teak is either girdled or green-felled depending on the market. Non-teak hardwoods are felled and extracted within a year. Extraction of timber is thus carried out within the bounds of the annual allowable cut (AAC). AAC is usually fixed for each felling series based on its growing stock. Re-adjusting of AAC is undertaken as required based on inventory data and girdling records. Cultural operations comprise sanitary and improvement felling in which climbers and inferior trees impeding the healthy growth of teak and other economically valuable species are removed. Healthy and phenotypically superior trees are left as mother trees to ensure natural regeneration. Today, timber harvesting is no mere an extraction of trees, but a silvicultural operation enhancing the growth of trees left in the forests and up keeping the diverse genetic resources.

Reforestation programme and large seeds requirement

In Myanmar, small scale plantation forestry started as early as in 1856 using *taungya* method. Large-scale plantation began in 1980 and over 32,000 ha of forest plantations using teak and other commercial species have annually been established since 1984 with various purposes (FD, 2003). The availability of an adequate amount of high-quality planting stock is essential for the establishment of large-scale plantations and maintenance of genetic diversity. Total planted areas and percentage by types of forest plantations and also by species are given in Tables 5 and 6 respectively.

Table 5. Areas of forest plantations by type by end of 2002 (Forestry in Myanmar, FD, 2003).

<i>Plantation type</i>	<i>Area (ha)</i>	<i>Percent of total area</i>
Commercial	418,550	55 %
Industrial	59,614	8 %
Village Supply	201,577	26 %
Watershed	87,776	11 %
Total	767,497	100 %

Table 6. Forest plantations by species by end of 2002 (by FD alone), (Forestry in Myanmar, FD, 2003).

<i>Species planted</i>	<i>Area (ha)</i>	<i>Percent of total area</i>
Teak (<i>Tectona grandis</i>)	319,953	42 %
Pyinkado (<i>Xylia xylocarpa</i>)	56,883	8 %
Padauk (<i>Pterocarpus macrocarpus</i>)	16,148	2 %
Pines (<i>Pinus</i> species)	19,122	2 %
Eucalyptus	76,189	10 %
Others	279,202	36 %
Total	767,497	100 %

Table 7. Tree species commonly used in plantation programmes.

<i>Local name</i>	<i>Scientific name</i>	<i>Uses</i>	<i>Remarks</i>
Kyun (Teak)	<i>Tectona grandis</i>	Commercial	Indigenous*
Pyinkado	<i>Xylia xylocarpa</i>	Commercial	Indigenous*
Padauk	<i>Pterocarpus macorcarpus</i>	Commercial	Indigenous*
Pine	<i>Pinus spp.</i>	Commercial	Indigenous*
Yemane	<i>Gmelina arborea</i>	Commercial	Indigenous*
Thit seint	<i>Terminalia bellerica</i>	Multipurpose	Indigenous*
Eucalypt	<i>Eucalyptus spp.</i>	Dry zone greening	Exotic
Tama	<i>Azadirachta indica</i>	Multipurpose	Indigenous*
Bawsagaing	<i>Leucaena leucocephala</i>	Multipurpose	Indigenous*
Kokka	<i>Allibizzia lebbek</i>	Multipurpose	Indigenous*
Mezali	<i>Accacia siamea</i>	Multipurpose	Indigenous*
Zi	<i>Ziziphus jujuba</i>	Multipurpose	Indigenous*
Magyi	<i>Tamarindus indica</i>	Multipurpose	Indigenous*
Paukpan-byu	<i>Sesbania grandisflora</i>	Multipurpose	Indigenous
Sha	<i>Acacia catechu</i>	Dry zone greening	Indigenous*
Subyu	<i>Acacia arabica</i>	Dry zone greening	Exotic
Tanaung	<i>Acacia leucoptera</i>	Dry zone greening	Indigenous
Sha-tanaung	<i>Acacia microcephala</i>	Dry zone greening	Indigenous
Auri-sha	<i>Acacia curculiformis</i>	Dry zone greening	Exotic
Senegal-sha	<i>Acacia senegalensis</i>	Dry zone greening	Exotic
Byu-che-dauk	<i>Rhizophora apiculata</i>	Mangrove reforestation	Indigenous*
Byu-che-daukma	<i>Rhizophora mucronata</i>	Mangrove reforestation	Indigenous
Byu-u-ta-lon	<i>Bruguiera gymnorrhiza</i>	Mangrove reforestation	Indigenous
Kanazo	<i>Heritiera fomes</i>	Mangrove reforestation	Indigenous
Kanbala	<i>Sonneratia apetala</i>	Mangrove reforestation	Indigenous*
Kaya	<i>Aegiceras corniculatum</i>	Mangrove reforestation	Indigenous
Madama	<i>Ceriops decandra</i>	Mangrove reforestation	Indigenous*
Myinga	<i>Cynometra ramiflora</i>	Mangrove reforestation	Indigenous
Thame	<i>Avicennia officinalis</i>	Mangrove reforestation	Indigenous*
Thayaw	<i>Excoecaria agallocha</i>	Mangrove reforestation	Indigenous

* Tree species are preferred by the local rural people and also planted in community forestry and annual tree planting programme across the country.

Out of forest plantations annually established, teak plantation (normal teak plantation and special teak plantation) constitutes about 20,000 ha. Naturally, a large amount of seeds of teak and other commercial species are required. In Myanmar, typical planting practice requires 1,330 seeds (seedlings) per hectare (i.e. 2.7 m x 2.7 m spacing). Therefore, total teak

seeds or seedlings required for 20,000-ha teak plantations amount to about 26.5 million or seedlings annually. The requirement of seeds for the plantations of other commercial species is more or less the same. The availability of quality seeds is limited in Myanmar. Although forest plantations have been established on a large scale for a long time, little is known about the sources of seeds. Seeds are generally collected from natural stands regardless of their localities. Large demand for improved seed and limited productivity of the existing seed production areas make the matters worse. The large scale forestation programmes have been launched using a number of tree species with various purposes including commercial plantation, watershed conservation, mangrove and dry zone rehabilitation. Table 7 shows the species commonly used in plantation programmes in Myanmar.

National capacity in FGR conservation and management **Organizations**

Four institutions under the Ministry of Forestry are performing their specific duties and responsibilities mainly related to forestry.

(a) Planning and Statistics Department (PSD)

It coordinates and facilitates the tasks of Forest Department, Myanmar Timber Enterprise and Dry Zone Greening Department following the directives of MOF, and deals mainly with policy matters and issues related to forestry.

(b) Forest Department (FD)

It is responsible for protection and conservation of biodiversity and sustainable forest management of the forest resources of the country.

(c) Myanmar Timber Enterprise (MTE)

It is responsible for timber harvesting, milling and downstream processing and marketing of forest products.

(d) Dry Zone Greening Department (DZGD)

It is responsible for restoration of degraded forest lands, protection and conservation of remaining natural forests, and restoration of the environment in the dry zone of the Central Myanmar.

Under the guidance of FD, the Forest Research Institute (FRI) and the Wildlife and Nature Conservation Division have been undertaking FGR C&M in Myanmar. The Division has been implementing protection and conservation of the wild fauna and flora through the establishment of Protected Area Systems (PAS) across the country. At present, the Division focuses on the conservation of wild fauna especially endangered and threatened animal species. Little attention can be given to FGR C&M due to various reasons.

FRI is taking responsibilities to conduct forestry and forestry related researches in order to provide technical information on all aspects of forest and forestry-based activities to increase the contribution of the forestry sector to the well-being of the nation.

FGR conservation and management is one of the major research priorities of FRI and the following are the major tasks of FRI:

- (a) Sustainable forest management in natural teak bearing forests;
- (b) Development of commercial plantations;
- (c) Genetic resources conservation of teak and other commercial species;
- (d) Restoration of degraded forests in the Dry Zone in Central Myanmar;
- (e) Efficient utilization of timber;
- (f) Development of non-wood forest products (NWFPs); and
- (g) Development of fuelwood resources and wood energy conservation measures

The Tree Improvement and Botany sub-division of FRI is currently conducting research activities concerning vegetative propagation of teak. FRI has also been undertaking teak tissue culture researches in cooperation with the Central Forestry Development Training Centre (CFDTC) of FD. Laboratory facilities for ex situ conservation are available at both institutions. However, equipment at FRI's lab has been used since 1978 and therefore are now outdated. There are three on-going projects related to bamboo genetic resource conservation and sustainable utilization and assessment of plant biodiversity in the national park. All are jointly implemented by FRI of the Forest Department and the international organizations, namely International Tropical Timber Organization (ITTO), International Plant Genetic Resource Institute (IPGRI) and ASEAN-Korea Environmental Cooperation Unit (AKECU).

Capacity building methods

In Myanmar, capacity building of the staff in the field of FGR conservation and management is urgently required in order to prevent the prevailing loss of FGR. In order to develop FGR conservation and management, short-term training courses on vegetative propagation techniques, establishment of seed production area (SPA) and teak hedge garden have been given regularly at FRI and CFDTC.

Public awareness

Conservation without local peoples' involvement is not a viable option. Peoples' participation will not be easily achieved unless the importance and role of FGR in the livelihood of the local people are widely spread out in rural societies. Generally, local people lack a general awareness of the benefits of the forests in the long run and the importance of conservation and sustainable utilization of the forest resources. Key information concerning FGR (if possible each and every species and its potential uses), their ecology and effects on the human-being can help to achieve peoples' participation, and this information can be used to develop better conservation plans with integrated approach. Traditional ways of collection of NWFPs and logging are not systematic and sustainable, thus damaging the forests to some extent. The practices can considerably reduce the population of tree species in the natural forests. Therefore, the awareness about the environment and importance of forests becomes a necessary ingredient for the conservation of forest genetic resources. Extension efforts and environmental education programmes are also the major imperatives for successful implementation of FGR conservation and management.

Institutional and political setting for FGR conservation and management

National forest policy and legislation

Myanmar Forest Policy was formulated in 1995 keeping in line with the forestry principles adopted at the United Nations Conference on Environment and Development (UNCED). Six imperatives identified in the policy are:

- Protection of soil, water, wildlife, biodiversity and the entire environment
- Sustainability of forest resources to ensure perpetual supply of both tangible and intangible benefits accrued from the forests for the present and future generations.
- Basic needs of the people for fuel, shelter, food and recreation;
- Efficiency to harness, in the socio-environmentally friendly manner, the full economic potential of the forest resources;
- Participation of the people in the conservation and utilization of forests; and
- Public awareness about the vital role of forests in the well-being and socio-economic development of the nation.

The Policy seeks to extend the Protected Area System (PAS) by gazetting 5% of the total land of the country from 4.7% at present to 10% in the long run. It also includes a system of environmental pricing based on the polluter pays principle to compensate for environmental and ecological degradation.

The new Forest Law focuses on the balance approach towards conservation and development issues implicit in the concept of sustainable forestry. Highlighting environmental and biodiversity conservation, the law encourages community forestry and people's participation in environmental and forest management. Legislation to protect the wildlife began with Burma Game Rules and the Elephant Protection Act, the heritage of the Indian legislation which has been in force for near century.

A separate legislation for Myanmar was promulgated only in 1936 in the Burma Wildlife Act. Since the old wildlife act did not reflect the present concept of wildlife and biodiversity conservation, the new legislation, Protection of Wildlife and Wild plants and Conservation of Natural Areas Law, was promulgated in 1994. The new law highlights habitat maintenance and restoration, protection of endangered and rare species of both fauna and flora, establishment of new parks and protected area systems and buffer zone management.

This Act is the basis for the protection of the flora and fauna of the country. Within the framework of the legislation, 6 national parks and 32 wildlife sanctuaries and wetlands have already been established throughout the country. Myanmar has actively participated in international cooperation programme concerning with the environmental affairs. It has made commitments to the following international agreements on forestry and other environmental issues:

- UN Convention to Combat Desertification (UNCCD) in those counties experiencing serious drought and/or desertification in January 1994,
- UN Framework Convention on Climate Change (UNFCCC) in November 1994,
- UN Convention on Biological Diversity (CDB) in November 1994,
- International Tropical Timber Organization (ITTO) in November 1993 and ratification of the International Tropical Timber Agreement in January 1996
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in June 1997.
- Botanical Gardens Conservation International in November 1998.
- The Cartagena Biosafety Protocol, a subsidiary agreement to the UN Convention on Biological Diversity in March 2001.

National FGR task force

Although it is well recognized that FGR conservation and management plays a vital role in the environmental stability and ecological balance, the conservation endeavors needed for sustainable utilization and development of FGR are not sufficient. Only little attention has been given in that field due to various constraints and limitations and thus national FGR task force for FGR conservation and management could not be organized in Myanmar. Nevertheless, Myanmar has been utilizing its FGR within the context of sustainable forest management and the national forest policy clearly mentions and concentrates on the conservation and management as mentioned above. Keeping in line with the internal trend and with the effective support of the national forest policy, it is expected to emerge national FGR task force soon under the Ministry of Forestry (MOF). Forest Department, Myanmar Timber Enterprise and Dry Zone Greening Department of MOF are the most relevant departments/organizations in order to carry out FGR-related decision-making process.

FGR conservation strategies and practices

National strategies for FGR C&M

Although the specific strategies for FGR C& M at the national level have not been identified, Myanmar forest policy clearly mentions the six imperatives including protection of soil, water, wildlife, biodiversity. The Forest Research Institute and Wildlife and Nature Conservation Division of the Forest Department have jointly identified and formulated the priority species and conservation strategies for FGR C&M, which would be the important step for elaboration of national level strategies.

Priority species and most pressing problems and threats on forest genetic resources

Most pressing problems and threats on forest genetic resources

Nowadays, especially in developing countries including Myanmar, the forests are degraded at an alarming rate due to some socioeconomic factors. In Myanmar, the most pressing problems threatening the forest genetic resources include:

- Forest degradation
- Over exploitation
- Illegal logging and illegal trade
- Shifting cultivation and agricultural expansion
- Urbanization and infrastructure development
- Forest fires (human-induced and lightning fires)
- Mining and building of dams

Proposed national priority species

Myanmar forest resources play an important role not only to fulfil the basic needs of rural people but also to contribute to the national economy. Therefore, identification of the priority plant species has been carried out based on the following criteria (IPGRI, 1998), which are suitable for the current conditions of the country.

- Ecological value
- Financial value (Nguyen Xuan Lieu, 2000)
 - Fit into the objectives of the planting programme
 - Bring high benefits
 - Have large and stable market
 - Availability of seed sources and propagation methods
 - Availability of planting and tending techniques
- Potential socio economic value
- Distribution pattern of the species and its population
- Distribution pattern of its genetic variation
- Threats imposed on the species
- Conservation status
- Reproductive biology
- Associated species

In Myanmar, detailed information on tree species is still lacking. There is a need to clearly identify and list out all rare, endangered and priority species. However, based on the above mentioned criteria, the following forest genetic resources have been identified and proposed as national priority species for conservation. The priority species mainly consists of valuable timber species, which are the most important timber species for the national economy development.

National conservation strategies

It is important to formulate appropriate strategies to conserve threatened genetic resources before they are lost forever. The strategies must be simple, flexible, and cost-effective as much as possible.

Table 8. Proposed national priority species for conservation.

<i>Local name</i>	<i>Scientific name</i>	<i>Commercial value</i>
Kyun	<i>Tectona grandis</i>	Very high
Pyinkado	<i>Xylia xylocarpa</i>	Very high
Padauk	<i>Pterocarpus macrocarpus</i>	Very high
Thingan	<i>Hopea odorata</i>	Very high
Thitya	<i>Shorea obtusa</i>	High
Ingyin	<i>Shorea siamensis</i>	High
Tamalan	<i>Dalbergia oliveri</i>	Very high
Kanyin	<i>Dipterocarpus turbinatus</i>	High
Karaway	<i>Cinnamomum obtusifolium</i>	High
Kashit	<i>Pentace burmanica</i>	High
Kokko	<i>Albizia lebbek</i>	High
Kya-na	<i>Xylocarpus molluccensis</i>	High
Sakawa	<i>Michelia champaca</i>	High
Sit	<i>Albizia procera</i>	High
Taung-tama	<i>Cedrela multijuga</i>	High
Tinyu	<i>Pinus khasya & Pinus merkusii</i>	High
Hnaw	<i>Adina wordifolia</i>	High
Pin-le-Kanaso	<i>Baccurea sapida</i>	High
Binga	<i>Mitragyna rotundifolia</i>	High
Magyi-pway	<i>Diospyros martabanica</i>	High
Hman-thin	<i>Cinnamomum iners</i>	High
Yinma	<i>Chukrasia velutina</i>	High
Yemane	<i>Gmelina arborea</i>	High
Yindaik	<i>Dalbergia cultrate</i>	High
Thadi	<i>Protium serratum</i>	High
Tinwun	<i>Milletia pendula</i>	High
Thitkado	<i>Toona ciliata</i>	High
Thit-hka-ya	<i>Diospyros oblonga</i>	High
Thitsi	<i>Melanorrhoea usitata</i>	High
Thitmagyi	<i>Albizia odoratissima</i>	High
Thitsho	<i>Pentace griffithii</i>	High
Anan	<i>Fagraea fragrans</i>	High
In	<i>Dipterocarpus tuberculatus</i>	High

Both in situ conservation and ex situ conservation strategies are important because in situ conservation is the ideal method of conserving wild plant genetic resources and ex situ conservation is a valuable complementary method for many species in order to secure genetic resources threatened with inevitable loss in their natural habitats (FAO, 1985). Therefore, they need to be considered complementary and be carried out in parallel as an integral part of the programmes. In order to fit in the actual situations of the country, and to be implemented as realistically as possible, the following forest genetic resource conservation strategies and practices are presented.

- strengthening protected areas system for FGRC
- sustainable forest management of natural forests for FGRC
- enhancement of seed production areas
- establishment of clonal seed orchards (CSO)
- strengthening and development of tissue culture methods

Strengthening PAS for FGR C&M

Protected Areas System (PAS) is the most suitable strategy for FGRC because PAS are the “areas especially dedicated to the protection and maintenance of biological diversity and associated cultural resources, and managed through legal or other effective means” (IUCN, 1994). They cover various situations ranging from managed resources areas, protected watersheds, national parks and strictly protected reserves, to sacred forest groves. In Myanmar, 6 national parks and 32 wildlife sanctuaries have been established so far throughout the nation covering 4.7% of the country’s total land area.

However, the management regimes of existing PAS are typically designed for conservation of forest ecosystems, which is often compatible with conservation of genetic resources in situ but not always so. The current PAS are not likely to provide conservation of important plant species. Therefore, PAS need to be designed for conservation of many species (especially priority species) and effectively conserved forest ecosystems can maintain a reservoir of continually evolving tree species and population. Thus, special measures need to be planned and undertaken in order to conserve, if possible, each species or habitat or biological diversity. FGR in PAS also need to be assigned consumptive and non-consumptive values so that the conservation of FGR can be linked to the sustainable socio-economic development of the local people.

Sustainable forest management for FGRC

SFM is the multipurpose management of the forest to ensure that its capacity to provide goods and services is not diminished over time (FAO, 1993). SFM and conservation of FGR are interdependent. Many target species are not adequately represented in protected areas, nor included in plantation and domestication programmes. The management practices of the forests in Myanmar are favoring the development of only a few commercial species overlooking the future use of other species which are not economically important at present. Therefore, the forest working plans need to have exhaustive lists of species and the working plan prescriptions must be extended to conserve all the species occurring in the area rather than covering only a few selected species. A list of endangered species, their distribution and status are necessary to document, update, and maintain for all areas (management units). More knowledge about the species, habitats and the intricate relationship between species are required for planning of FGR conservation and management. Similar information regarding species which are commercially exploited (legal or illegal) must be well documented and their illegal exploitation must be curbed. Accordingly, harmonizing conservation and management objectives and practices in production-oriented or multiple-use native forests is essential for conservation of forest genetic resources of the above-mentioned species.

As one of the key objectives of SFM is the maintenance of viable breeding populations of the main commercial timber species as well as species which provide non-wood forest products for local communities, monitoring and assessment on the current forest management practices are needed. Detailed planning and good management, including special attention to basis silvicultural practices, can ensure compatibility among the sustainable productive, protective and social functions of the forests. Then management interventions are necessary that will better ensure genetic conservation, and need to be properly integrated into forest management practices.

Enhancement of seed production areas (SPA)

The simplest way to produce seeds used for commercial plantations as part of a breeding programme is the establishment and management of Seed Production Areas (SPAs). The seed production areas will become the backbone of Myanmar for the production of superior seeds of teak and other commercial species for future. The seeds produced in SPAs can be immediately used and replaced uncontrolled harvested reproductive materials. Production of propagative materials in well-managed seed production areas is a very important step towards a sustainable use of forest genetic resources.

SPAs serve a dual function: as the areas used for seed procurement and for in situ conservation of forest genetic resources. Both natural forests and plantations can serve as SPAs if they meet the criteria. Therefore, it is suggested that conversion of well-adapted plantations of teak and other commercial species into SPAs be carried out (in each seed zone) throughout the country with momentum. Existing SPAs (mainly plantations) must be maintained systematically.

The establishment of SPA in Myanmar was started by the East Bago Yomas Plantation Project in the early 1980s. Since then seed production areas have increasingly been taking place as seed sources for teak and other commercial plantations. Up to 2003, some 98 SPAs, having a total area of about 2,063 ha, have been setup throughout the country, and details are shown in Table 8.

Table 9. Area of SPA by species (Forestry facts, FD, 2003).

<i>Species</i>	<i>No. of SPA</i>	<i>Area (ha)</i>
Teak (<i>Tectona grandis</i>)	83	1,774
Pyinkado (<i>Xylia xylocarpa</i>)	7	216
Pinus spp.	5	12
Yemane (<i>Gmelina arborea</i>)	2	20
Byu-u-ta-lon (<i>Bruguiera gymnorhiza</i>)	1	41
Total	98	2,063

The present SPAs cannot fulfill the large amount of seeds required for the current reforestation programme. Thus, establishment of SPAs for teak and other priority species must be encouraged and urgently implemented throughout the country (in each relevant seed zone).

Establishment of clonal seed orchards (CSO)

Clonal Seed Orchards are established in order to produce large quantities of seeds from a limited number of selected genotypes. Selected genotypes are cloned and many copies assembled to a population. In Myanmar, clonal plantations of teak and other commercial species are expected to be more costly, lower in biodiversity and more risky than conventional plantations, but do not offer benefits with regard to the expected yield (Reiner Finkeldey, 2002).

However, research and development of clonal propagation methods need to be encouraged although the establishment of large-scale clonal plantation is not recommended. The vegetative propagation will be important for preparation and implementation of the FGR conservation and management plan (strategies) and for the following tasks:

- conservation of “Plus trees” genotypes of endangered species in in situ reserves
- establishment of clonal tests as part of the long-term multiple propagation breeding strategy
- establishment of additional CSOs as part of long-term breeding strategy

In Myanmar, teak seed orchards were established in Bago and Mandalay Divisions in 1981. A clonal seed orchard (CSO) of 34 ha was established in Toungoo District of Bago Division and one of 6 ha at a research station in the Yemathin District of Mandalay Division. The Forest Research Institute (FRI) of the FD has been conducting germination tests on seeds collected from these orchards.

Establishment of Hedge Gardens for teak and other priority species is an option for conservation of FGR. Both clonal and seedling Hedge Gardens can be applied in order to ensure the sustained production of planting stock for plantations. It is simple, flexible, cost efficient and widely applicable in large scale plantation forestry because conventional vegetation propagation methods, such as grafting, budding, layering and cutting could easily be applied for clonal propagation and establishment of Hedge Gardens, germplasm. Research on shoot-cutting was successfully experimented by FRI, Yezin in 1995-96. On-site planting of rooted cuttings of teak from Teak Hedge Garden have been introduced in some forest districts in 2002. The establishment and development of Hedge Gardens for teak and priority species are much more needed to provide future large scale programme.

Strengthening and development of tissue culture methods

Tissue culture has become one of the key elements in the successful promoting of plantation forestry. Planting materials need not only be of adequate supply but also high quality. Mass production of quality planting materials could only be achieved by tissue culture. In Myanmar, research on tissue culture of teak has started in late 1990s and the first batch of teak plants have been field planted. These plants are being observed growing with good health and performance. However, this achievement is still at the experimental stage and it need to be developed with momentum not only for the technical aspects but also for the mass production with reasonable costs per hectare.

National budget for FGR activities

Specific budget is not allocated for FGR C&M. In order to conserve FGR, the Wildlife and Nature Conservation Division and the Forest Research Institute of the Forest Department use some portion of their own budget for research and development of FGR C&M as well as establishment of new in situ and ex situ conservation areas etc.

Challenges in FGR C&M

The following are the challenges to be addressed in developing and strengthening the FGR C&M.

- development of capable and sufficient human resource in the field of FGR C&M
- development of adequate knowledge base with respect to ecological information of flora
- allocation of adequate budget for research and development of FGR C&M

The above mentioned challenges are common in almost all developing countries and Myanmar is no exception. However, it can be overcome through the coordination among relevant Government Ministries, NGOs and International organizations. Capacity building programmes including short-term and long-term trainings, sharing and exchange of information and technology on FGR C& M within the APFORGEN countries will definitely contribute to solve these obstacles.

FGR management in the community level

People's participation in forest management and conservation is highly appreciated and encouraged in Myanmar by formulating Community Forestry Instructions (CFIs) in 1995. It is a major breakthrough in forestry sector in order to keep pace with the changing socio-economic and environmental concerns. Community forestry aims at conserving forest resources, regaining environmental stability and addressing socio-economic needs of local communities (FD, 1995). It was initially implemented in the three critical areas of the dry zone, the watershed regions and the mangrove zones. At present, the community forestry programme has been launched throughout the country and so far an area of 68843 ha of community forests were established in all the States and Divisions of the country (FD, 2003).

Community forestry programs are being implemented in two forms: FD implemented program and FD and international organizations such as UNDP/FAO jointly implemented programs. Although the current community forestry projects are designated especially for the rehabilitation of the degraded forest lands, conservation of forest genetic resources in its natural habitats are also included as an essential component. These projects are successful in the Dry Zone of the Central Myanmar, hilly regions and mangrove areas.

Regional collaboration on FGR C&M

It is expected to build friendship among the member countries through participation in APFORGEN. As a result, strengthening and development of FGR C&M activities at the national and regional level could be implemented. Information exchange programmes, contributing long-term and short-term training courses on propagation techniques and in situ and ex situ conservation between the APFORGEN countries would be effective for long-term FGR C&M in the national and regional level as well. The areas that urgently call for collaboration within the context of FGR C&M include project planning, assessment and evaluation, management of PAS and natural forest for FGR conservation, vegetative propagation methods, tissue culture and biotechnology.

Conclusion

Given the situation in Myanmar, it is obvious that more efforts and endeavours are needed as far as FGR conservation and management is concerned. In order to strengthen and promote FGR conservation and management in Myanmar, capacity building is inevitably required because FD staff and relevant partners with adequate skills to implement FGR C&M programmes effectively and efficiently are rather limited. In addition, budget, physical infrastructure and laboratory facilities, etc. also need to be upgraded.

Today, the issue of FGR C&M has become a global concern. The concept of FGR C&M has changed in that the forests existing in a county is not just its own resources but the heritage of the rest of the world. As such, a country should implement FGR C&M activities in collaboration and cooperation with other countries, particularly neighbouring countries. A country must fully realize its commitments in accordance with the signed international and regional treaties, conventions and agreements. Views and experiences in relation to planning and implementation of the FGR C&M programmes should be exchanged through networking, workshops and seminars for present and future benefits of mankind.

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Annex 1

Status of FGR conservation and management and responsible organizations in Myanmar.
None of the organizations has laboratories of molecular or genetic markers.

	<i>Forest Research Institute (FRI)</i>	<i>Wildlife and Nature Conservation Division (WNCD)</i>	<i>Central Forestry Development Training Centre (CFDTC)</i>
Address	Yezin, Myanmar.	Director-General's Office, Forest Department, West Gyogone, Bayinnaung Road, Insein Tsp. Yangon-Myanmar	Hmaw-bi, Myanmar
No. of staff in FGR	4	-	3
Ex situ conservation facilities	<ul style="list-style-type: none"> • 1 lab. • 1 mist chamber • Propagation facilities 	<ul style="list-style-type: none"> • No lab. • Just little attention could be given in FGR C and M. • The division is focusing on protection and conservation of wild animals. 	<ul style="list-style-type: none"> • Teak tissue culture facilities
In situ areas	<ul style="list-style-type: none"> • Three seed orchards (65 ha) • -One SPA (25 ha) 	<ul style="list-style-type: none"> • 38 Protected Areas (PAs). • 4.7% of country's total area. 	<ul style="list-style-type: none"> • -
Capacity building needs	<ul style="list-style-type: none"> • Short term trainings, Master and Ph. D degree holders are needed in the field of FGR C&M and biotechnology. 	<ul style="list-style-type: none"> • Management and conservation of PAS for FGR. 	<ul style="list-style-type: none"> • Tissue culture technologies.
Current major FGR projects	<ul style="list-style-type: none"> • Conservation of bamboo species project funded by IPGRI. • Sustainable utilization and conservation of bamboo species project funded by ITTO. • Assessment on plant biodiversity project funded by AKECU. 	<ul style="list-style-type: none"> • - 	<ul style="list-style-type: none"> • -